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Characterization of Soybean Extract Drinks Using Ambon Banana Peel Waste as a Source of Calcium

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ABSTRACT

Potassium is an important mineral that has many roles in the body. Potassium can be found in fruits and nuts such as ambon banana and soybeans. Ambon banana peel is part of the ambon banana which has not been widely used as processed food or drink. This study aims to determine the best quality ambon banana peel soybean extract based on physical, chemical, and organoleptic characteristics. This research used an experimental method with a completely randomized design (CRD) with one factor with three replications consisting of 6 concentration levels of ambon banana peel extract (P1=10%, P2=15%, P3=20%, P4=25%, P5 = 30%, P6=35). The results showed that the concentration of ambon banana peel was significantly different (α=0.05) on viscosity, stability, total dissolved solids, pH, protein content, fat content, color and taste hedonic tests, hedonic quality tests for color, and taste. However, it was not significantly different in the hedonic aroma and texture test. The best treatment chosen in this study was the P2 treatment (15%) with a viscosity value of 5.52 cps, a stability value of 94.42%, a pH value of 6.71, a total dissolved solids value of 11.07 ^{o}Brix, a potassium content of 31.01 mg/100mL, a fat content of 1.42%, a protein content 2.35%, and the overall hedonic value is like the quality attributes of brownish white color, odorless, watery texture, and sweet taste.

Keywords: potassium, soybean extract, ambon banana peel

INTRODUCTION

Minerals are nutrients that the body needs for a variety of processes in cells, tissues, organs, and metabolic stages (Susanti et al., 2016). Along with salt, potassium contributes to the maintenance of fluid and acid-base balance as well as osmotic pressure. In contrast, potassium works with calcium to facilitate neuronal conduction and muscle relaxation (Tulungnen et al., 2017). A particular mineral called potassium can aid in the prevention of degenerative conditions like heart disease, hypertension, and stroke (Rania, 2022). Some sources of potassium include fruit and nuts.

Soymilk is one of the processed vegetable products drinks made from soybeans (*Glycine max* L.). Protein, fat, vitamins, and minerals can all be found in soy products. However, some people still don't like soy sauce because it lacks the unpleasant aroma. Soybeans contain the mineral potassium (1504 mg) greater than other types of beans such as green beans (1132 mg), red beans (1151 mg), and peanuts (412 mg).

Apart from soybeans, yellow fruits also contain very good potassium, one of which is bananas (Dewi et al., 2021).

The ambon banana (*Musa paradisiaca var.sapientum*) is one of the most widely consumed types of bananas by Indonesian people. According to the National Socio-Economic Survey (SUSENAS), the Indonesian population's annual per capita consumption of bananas in 2020 will be 1,712 kg for ambon bananas and 4,887 kg for other bananas (Data Center and Agricultural Information System, 2021). Because ambon bananas are consumed at a relatively high rate, more ambon banana peel waste will be produced. The peels of ambon bananas are a rich source of water, vitamins, minerals, fats, and carbohydrates (Muztniar, 2017).

The mineral content of potassium in the ambon banana peel is 882.38 mg/100g while in the banana flesh, it is 359.19 mg/100g (Taslim et al., 2021). Banana peels aren't typically used for anything other than animal feed or waste, though (Salimi and Payu, 2019). The potential for banana peel waste is estimated at 2.09 tons per year (Ibnu et al., 2022). This is because there are quite a few banana peels compared to the quantity of bananas that are still peeled, which is roughly 1/3.

Ambon banana consumption is fairly high, and improper handling of banana peel trash can result in an accumulation of garbage that is bad for the environment. The decomposition of banana peels will result in the production of harmful gases including hydrogen sulfide and ammonia (Nuriawati and Dahliaty, 2016). Banana peels are said to help cover up the bad smell of soy sauce because of their high lignin aromatic component concentration (27.8%), which is in addition to their nutritional value and inclusion of the mineral potassium (Novianti and Setyowati, 2016).

Research on soymilk beverage products with the addition of ambon banana peel waste has never been done. So, based on the description above, it makes researchers interested in developing soybean extract products by utilizing the addition of ambon banana peel extract so that it can be an alternative product for potassium-source drinks, reducing ambon banana peel waste, and increasing product acceptability. Thus, this research was conducted to determine the best concentration of the addition of ambon banana peel extract on the quality of soy sauce on physical, chemical, and organoleptic characteristics.

MATERIALS AND METHODS

Tools and materials

The tools used in this study included scales, pans, basins, blenders, knives, filter cloths, stirrers, stoves, glass bottles/plastic bottles, measuring cups, and thermometers. Tools for chemical and physical analysis, namely refractometer (Atago Master-M cat.No2313), viscometer (Brookfield LVDVE 8535022), burette, kjeldahl flask, desiccator, oven, soxhlet, fat flask, pH meter (Jenway 3510), Atomic Absorption Spectrophotometer (AAS) λ 7065 nm, volumetric flask, analytical balance, filter paper, beaker glass, boiling stone, Erlenmeyer, pipette drops, volume pipette. While the tools for organoleptic tests, namely glass cups, tissues, and pens. The ingredients used consist of soybeans, ambon banana peel, water, sugar, and vanilla. The materials for analysis, namely aquadest, hexane solution, 4 M HCL solution, concentrated H_2SO_4, kjeldahl tablets, 2% boric acid, 32% NaOH, 0.1 N HCL.

Processing of Ambon Banana peel extract

The process of making ambon banana peel extract follows the method of Ago et al. (2014) modified. The manufacturing steps are sorting, weighing, washing, crushing the ambon banana peels with the addition of 1:2

(w/v) water, and the samples were filtered to uniformize the filtrate size

Processing of Ambon Banana peel soybean extract

The process for making ambon banana peel extract follows the modified Margareta (2021) method, with the modification of adding hot water during the crushing process and adding sugar and vanilla composition to the product. The manufacturing steps are weighing, boiling for 15 minutes with a water ratio of 1:3 (w/v), soaking for 12 hours with water 1:3 (w/v), stripping and washing again, crushing with the addition of hot water 1:5 (b/v), filtering, mixing 8% sugar and 0.15% vanilla, and ambon banana peel extract and cooking for 10 minutes with a temperature of 80-85^{o}C. This research used an experimental method with a completely randomized design (CRD) with one factor with three replications consisting of 6 concentration levels of ambon banana peel extract (P1=10%, P2=15%, P3=20%, P4=25%, P5 = 30%, P6=35).

Testing techniques

Physical tests include viscosity tests (AOAC, 2005) and stability tests (Aziz, 2009 in Sabariman, 2022), chemical tests include pH tests (AOAC, 2012), total dissolved solids (AOAC, 2012), protein content (SNI 01-2891 -1992), fat content (SNI 01-2891-1992), and potassium content (AOAC 985.35/50.1-14 2005) as well as organoleptic tests including hedonic tests (SNI 01-2346-2006) and hedonic quality tests for color, aroma, texture, and taste.

Statistical analysis

Data analysis from research results was carried out descriptively and inferentially. Descriptive analysis was carried out to determine the trend in the quality of soy milk due to the addition of Ambon banana peel juice added with different concentrations. The analysis technique used was Analysis of Variance (ANOVA) with a completely randomized design with six levels of one factor with three repetitions. The ANOVA test was carried out to determine whether there was a difference between the quality of soy milk added with Ambon banana peel juice at different concentrations.

RESULTS AND DISCUSSION

Phisycal test

Viscosity test

The results of the ANOVA viscosity test showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of the concentration of ambon banana peel extract has a significant effect on the viscosity value of the soybean extract drink at a significance level of 0.05.

The results of the research on the viscosity test value showed that the higher the concentration of ambon banana peel extract, the higher the viscosity. The increase in the viscosity value for each treatment was due to the greater concentration of ambon banana peels added which caused the product to become thicker. This is because ambon banana peel contains pectin and starch in it. According to Tuhuloula et al. (2013), the pectin concentration of ambon banana skin is 14.89%. The ambon banana peel, meanwhile, contains 29.37% starch (Saragih et al., 2021). According to Mustapa et al. (2022) statements, pectin and starch will react when heated during the cooking process, increasing the product's thickness. In addition to the dissolved pectin forming a fine fiber that serves to hold liquids and improve the product's thickness, the heating process causes the starch solution to gelatinize.

Stability test

The results of the ANOVA stability test showed that the ambon banana peel soybean

extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of the concentration of ambon banana peel extract has a significant effect on the stability value of the soybean extract drink at a significance level of 0.05.

The results of the stability test showed that the higher the concentration of ambon banana peel extract, the lower the stability value. The product's increasing amount of deposits is the cause of the lowering stability value (Wardhani, 2020). Pectin and pectinase enzymes are found in fruit, particularly banana peels, where they depolymerize pectin into galacturonic acid and produce precipitates that alter stability (Farikha et al., 2013). The stability value is inversely proportional to the product viscosity, when the product viscosity increases the stability value decreases. This is consistent with the claim made by Kumalasari et al. (2013) that the breakdown of pectin will result in viscosity, meaning that the thicker the product, the less consistent it will be and the more unstable it will become.

Chemical test

pH test

The results of the ANOVA pH test showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of the concentration of ambon banana peel extract has a significant effect on the stability value of the soybean extract drink at a significance level of 0.05.

The results of the research on the pH test value showed that the higher the addition of the concentration of ambon banana peel extract, the higher the pH. The increased pH value was due to the peel of the ambon banana having a higher pH of 6.5 compared to the flesh of the ambon banana which had a pH of 4.1 (Trianti and Pranita, 2015). The higher the pH value of a food ingredient, the lower the acidity level, conversely, the lower the pH value, the higher the acidity level (Sabariman, 2022). Based on the results of the research that has been carried out, it was found that the conditions of ambon banana peel soybean extract were not too acidic and not too alkaline or neutral so all concentration treatments of adding ambon banana peel extract to soybean extract were in good condition in accordance with the SNI quality requirements for soy milk, namely 6.5-7.0.

Total dissolved solids test

The results of the ANOVA test for total dissolved solids showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of the concentration of ambon banana peel extract has a significant effect on the total dissolved solids value of the soymilk drink at a significance level of 0.05.

The results of the research on total dissolved solids test values show that the higher the concentration of ambon banana peel extract, the higher the total dissolved solids. The presence of complex substances such as proteins and carbohydrates which break down into simpler compounds can increase the total dissolved solids in a solution (Sihombing et al., 2013). The pectin included in ambon banana peels as well as the sugar addition may be to blame for the rise in total dissolved solids. This is consistent with Simamora and Rossi's (2017) claim that the presence of soluble pectin and the addition of granulated sugar can contribute to an increase in total dissolved solids.

Test potassium levels

The results of the ANOVA test for potassium levels show that the ambon banana peel soybean extract drink has a Sig value > 0.05, which means H0 is accepted and HI is

rejected. This explains that adding the concentration of ambon banana peel extract has no significant effect on the potassium content of soybean extract drinks at the 0.05 significance level. So there is no need to carry out further DMRT examinations to test potassium levels in ambon banana peel soybean extract drinks.

The results of the potassium level test showed that the higher the concentration of ambon banana peel added, the higher the potassium level obtained. However, the results of potassium levels which did not have a real effect were probably caused by differences in the concentration of ambon banana peel extract which were not too different between treatments. The potassium content which is not as high as the potassium content in the main ingredient can be caused by the presence of phytic acid which is an anti-nutritional compound in soybeans. The presence of phytic acid as an anti-nutrition can cause the formation of complexes with minerals. Phytic acid can bind potassium minerals, causing the minerals to be insoluble and reducing the nutritional value of the product because it cannot be absorbed by the body, so the ingredients used need to be processed first. However, the processing process can cause potassium to be wasted along with phytic acid (Pangaribuan, 2018). Apart from that, potassium has the property of being easily soluble in water, so using large amounts of water in the crushing process can also cause potassium minerals to be lost because these minerals will dissolve and be wasted or evaporate during the cooking process (Damanik et al., 2021).

Based on nutritional content claims, a food product in liquid form can be claimed as a source of potassium if it contains 7.5% per 100 ml (BPOM, 2016). Based on Almatsier in 2010, daily potassium intake is said to be sufficient if you consume potassium at least 2000 mg/day. A total of 500 mL of ambon banana peel soy extract is served per serving, so consuming 500 mL of ambon banana peel soy extract per day can meet more than 7.5% of daily potassium needs. So, all treatments of the ambon banana peel soybean extract drink can be claimed as a source of potassium drink. Meanwhile, if you follow the serving size of commercial soy milk of 300 ml per serving to meet the needs of 7.5% of daily potassium intake of 2000 mg/day, ambon banana peel soy milk can be consumed in 2 servings.

Fat content

The ANOVA results of the fat content test show that the ambon banana peel soybean extract drink has a Sig value <0.05, which means H0 is rejected and HI is accepted. This explains that the addition of ambon banana peel extract concentration has a significant effect on the fat content value of soybean extract drinks at a significance level of 0.05.

The results of research on fat content test values show that the higher the concentration of ambon banana peel extract, the higher the fat content value. The nutritional content, including the fat in the ambon banana peel, can be affected by the maturity level of the fruit (Dewi et al., 2021). Loss of fat content can occur due to damage to the fat structure due to fat being hydrolyzed into glycerol and fatty acids (Picauly et al., 2015). In addition, it is believed that the lower fat level is due to the fiber in banana peels, which works to lower the fat content of food items (Winarno, 2004 in Maitimu, 2020). Based on the results of research on fat content that has been carried out, it was found that the condition of ambon banana peel soy milk in all treatments was in good condition in accordance with the SNI quality requirements for soy milk by 1.0% w/w.

Protein content

The results of the ANOVA test for protein content showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of the concentration of ambon banana peel extract has a significant effect on the value of the protein content of the soybean extract drink at a significance level of 0.05.

The results of the protein content test showed that the higher the concentration of ambon banana peel extract, the lower the protein content. The decreased value of protein content caused by the protein content in ambon banana peel which is smaller at 0.32g/100gram compared to the protein content in soybean extract of 3.5g/100gram. The protein content in ambon banana peels can also be affected by variety, age, and type of processing. In addition, based on Maitimu statement (2020) the protein contained in banana peels is a globular protein, where the polar hydrophilic side chains are on the outside, so the protein in ambon banana peels has high solubility in water, so the amount of water used in the crushing stage of ambon banana peel extract has a big influence. Increasing the protein content can be done by reducing the amount of water in the raw material (Firdiansyah, 2004 in Picaul et al., 2015). Based on the results of the research on protein content that had been carried out, it was found that the condition of ambon banana peel soybean extract was in good condition, in accordance with the SNI quality requirements for soy milk 2.0% w/w.

Organoleptic test

Hedonic test and color hedonic quality

The results of the ANOVA color hedonic test showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of ambon banana peel extract has a significant effect on the hedonic test of the color of the ambon banana peel soybean extract drink at a significance level of 0.05. Meanwhile, the ANOVA results of the color hedonic quality test showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of ambon banana peel extract has a significant effect on the hedonic test of the color of the ambon banana peel soybean extract drink at a significance level of 0.05.

The more concentration of ambon banana peels, the more brown the soya bean drink will be. This is in line with Nayoan research (2014) which stated that the brownish color of ambon banana peels was thought to occur due to browning reactions which enzymatically occurred due to the substrate content of phenolic compounds found in banana peels. The browning process is influenced by phenolic compound substrates of the orthodihydroxy or trihydroxy type. The enzymatic reaction is triggered by the oxidase enzyme, so when the banana peel is peeled and exposed to oxygen it will cause browning (Arsa, 2016). Apart from that, browning can also be caused by the caramelization of sugar on the peel of ambon bananas due to cooking (Sangur, 2020).

Aroma hedonic test and quality

The ANOVA results of the hedonic test on the aroma of the ambon banana peel soybean extract drink showed that the ambon banana peel soybean extract drink had a Sig value >0.05, which means H0 was accepted and HI was rejected. This explains that the addition of ambon banana peel extract has no significant effect on the hedonic test of the color of the ambon banana peel soybean extract drink at a significance level of 0.05. Meanwhile, the ANOVA results of the hedonic quality test for the aroma of the ambon banana peel soybean extract drink

showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means H0 was rejected and HI was accepted. This explains that the addition of ambon banana peel extract has a significant effect on the hedonic test of the aroma of the ambon banana peel soybean extract drink at a significance level of 0.05

According to Trihaditia and Zaenudin (2022), soybeans have an unpleasant aroma which is caused by the activity of the lipoxygenase enzyme which can hydrolyze polyunsaturated fatty acids to produce volatile compounds that cause an unpleasant aroma. The increasing concentration of ambon banana peel extract is thought to provide a distinctive banana aroma that can cover the unpleasant aroma of soybeans. This is in line with the statement by Novianti and Setyowati (2016) who stated that banana peels contain quite a large aromatic lignin compound, namely 27.8%. Apart from that, the aroma of the banana peel will also appear and become stronger due to the addition of vanilla and the sugar caramelization reaction in the banana peel due to cooking (Hidiarti and Srimiati, 2019).

Hedonic test and textured hedonic quality

The results of the ANOVA test on the hedonic texture of the ambon banana peel soybean extract drink showed that the ambon banana peel soybean extract drink had a Sig value >0.05, which means that H0 was accepted and HI was rejected. This explains that the addition of ambon banana peel extract had no significant effect on the hedonic test of the color of the ambon banana peel soybean extract drink at a significance level of 0.05. Meanwhile, the results of the ANOVA test for the hedonic quality of the texture of the ambon banana peel soybean extract drink showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of ambon banana peel extract has a significant effect on the hedonic test of the texture of the ambon banana peel soybean extract drink at a significance level of 0.05

The expected texture of this ambon banana peel soybean extract drink is runny. Also related to the results of viscosity and stability testing, the higher concentration of ambon banana peel extract added produces a texture that is not too runny (thicker) and stability decreases. This is because ambon banana peels contain a pectin component that can stabilize and bind water (Trihaditia and Zaenudin, 2022).

Hedonic test and taste hedonic quality

The ANOVA results of the hedonic test on the taste of the ambon banana soybean extract drink showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of ambon banana peel extract has a significant effect on the hedonic test of the taste of the ambon banana peel soybean extract drink at a significance level of 0.05. Meanwhile, the ANOVA results of the hedonic quality test on the taste of the ambon banana peel soybean extract drink showed that the ambon banana peel soybean extract drink had a Sig value <0.05, which means that H0 was rejected and HI was accepted. This explains that the addition of ambon banana peel extract has a significant effect on the hedonic test of the taste of the ambon banana peel soybean extract drink at a significance level of 0.05. The sweet taste of the ambon banana soybean extract drink is obtained from ingredients such as sugar and vanilla which are used as additives. The more concentration of ambon banana peel extract added, the less bitter it will taste. This is in line with the research of Trihaditia and Zaenudin (2022) which stated that banana peels have a bitter astringent taste due to the

presence of tannin compounds which have a bitter taste from their polyphenol groups.

CONCLUSION

Based on the results of research on making soybean extract drinks with the addition of ambon banana peel extract (10%, 15%, 20%, 25%, 30%, 35%) there is a significant difference (α=0.05) in the values of viscosity, stability, total dissolved solids, pH, protein content, fat content, hedonic test for color and taste parameters, hedonic quality test for color, aroma, texture and taste parameters. However, there was no significant difference in the potassium levels and hedonic aroma and texture tests.

The selected ambon banana peel soybean extract drink was the P2 treatment, namely with the addition of a concentration of ambon banana peel extract of 15%. The selected ambon banana peel soybean extract drink can be claimed as a potassium source drink with a viscosity value of 5.52 cps, stability value of 94.42%, pH value of 6.71, total dissolved solids value of 11.07 ^{0}brix, potassium content of 31.01 mg/100mL, fat content of 1.42%, protein content 2.35%, and hedonic value of color 4.76 (like), aroma 4.78 (like), texture 4.77 (like), taste 4.84 (like) with hedonic quality value of color 4.61 (brownish white), aroma 4.65 (not unpleasant), texture 4.76 (watery), and taste 4.82 (sweet).

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Table 1. Physical test value of ambon banana peel soybean extract drink

Concentration of ambon banana peel extract (w/w)	Physical Test	
	Viscosity	Stability
10%	5.31 ± 0.2[a]	94.40 ± 0.0[c]
15%	5.52 ± 0.2[a]	94.42 ± 0.1[c]
20%	7.56 ± 0.3[b]	94.70 ± 0.0[d]
25%	7.80 ± 0.5[b]	93.91 ± 0.1[b]
30%	8.04 ± 0.5[b]	93.85 ± 0.1[b]
35%	8.38 ± 0.7[b]	93.66 ± 0.0[a]

Note: Value with different notation has a significant difference in the Duncan test α = 0.05

Table 2. Chemical test value of ambon banana peel soybean extract drink

Concentration of ambon banana peel extract	Chemical Test				
	pH	Total Dissolved Solids (ppm)	Potassium Levels (mg/kg)	Fat Content (/100g)	Protein Content (/100g)
10%	6.63 ± 0.1[a]	11.03 ± 0.1[a]	30.52	1.46 ± 0.1[d]	2.28 ± 0.1[c]
15%	6.71 ± 0.0[b]	11.07 ± 0.1[a]	31.01	1.42 ± 0.1[d]	2.35 ± 0.0[c]
20%	6.74 ± 0.0[b]	11.10 ± 0.1[ab]	32.82	1.25 ± 0.0[c]	1.31 ± 0.0[a]
25%	6.74 ± 0.0[b]	11.20 ± 0.0[bc]	32.76	1.19 ± 0.0[bc]	1.25 ± 0.1[a]
30%	6.82 ± 0.0[c]	11.23 ± 0.1[c]	32.76	1.16 ± 0.0[ab]	1.50 ± 0.0[b]
35%	6.85 ± 0.1[c]	11.27 ± 0.1[c]	33.84	1.09 ± 0.0[a]	1.27 ± 0.1[a]

Note: Value with different notation has a significant difference in the Duncan test α = 0.05

Table 3. Hedonic test value of ambon banana peel soybean extract drink

Concentration of ambon banana peel extract	Hedonic Test			
	Color	Aroma	Texture	Taste
10%	5 ± 0.1 e	5 ± 0.3	5 ± 0.1	5 ± 0.2 c
15%	5 ± 0.1 e	5 ± 0.1	5 ± 0.2	5 ± 0.1 c
20%	4 ± 0.1 d	5 ± 0.1	5 ± 0.2	5 ± 0.1 c
25%	4 ± 0.2 c	5 ± 0.1	5 ± 0.1	5 ± 0.2 bc
30%	3 ± 0.2 b	5 ± 0.2	5 ± 0.1	4 ± 0.1 b
35%	3 ± 0.1 a	5 ± 0.1	4 ± 0.1	4 ± 0.3 a

Note: Value with different notation has a significant difference in the Duncan test α = 0.05

Table 4. Hedonic quality test value of ambon banana peel soybean extract drink

Concentration of ambon banana peel extract	Hedonic Quality Test			
	Color	Aroma	Texture	Taste
10%	5 ± 0.1 d	4 ± 0.2 a	5 ± 0.1 c	5 ± 0.2 c
15%	5 ± 0.2 d	5 ± 0.1 b	5 ± 0.2 c	5 ± 0.1 b
20%	4 ± 0.1 c	5 ± 0.1 b	5 ± 0.2 bc	5 ± 0.1 b
25%	4 ± 0.2 b	5 ± 0.1 b	5 ± 0.1 bc	4 ± 0.1 a
30%	3 ± 0.1 a	5 ± 0.1 b	4 ± 0.1 ab	4 ± 0.2 a
35%	3 ± 0.2 a	5 ± 0.2 b	4 ± 0.1 a	4 ± 0.3 a

Note: Value with different notation has a significant difference in the Duncan test $\alpha = 0.05$